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(54) **SYSTEM AND METHOD FOR DIAGNOSING A FAULT IN A CAMSHAFT POSITION SENSOR AND/OR A CRANKSHAFT POSITION SENSOR**

(71) Applicant: **GM Global Technology Operations LLC**, Detroit, MI (US)

(72) Inventors: **Thomas F. Porlick**, Brighton, MI (US); **Kevin A. Sherwin**, Farmington Hills, MI (US); **Layne K. Wiggins**, Dexter, MI (US)

(73) Assignee: **GM Global Technology Operations LLC**, Detroit, MI (US)

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F02D 41/00	(2006.01)
F02D 41/26	(2006.01)

(52) **U.S. Cl.**
CPC ***F02D 41/222*** (2013.01); ***F02D 41/009*** (2013.01); ***F02D 41/22*** (2013.01); ***F02D 41/263*** (2013.01)

(58) **Field of Classification Search**
CPC ... F02D 41/009; F02D 41/222; F02D 41/263; F02D 41/22
See application file for complete search history.

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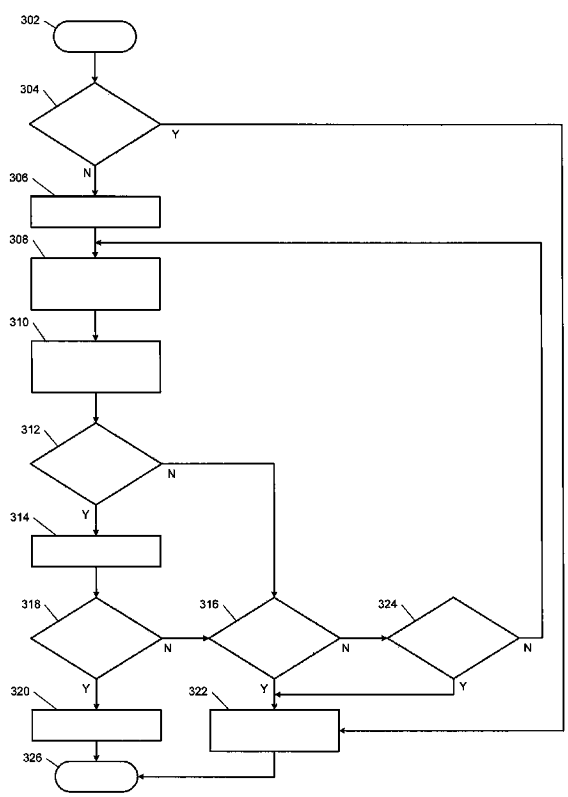
Primary Examiner — Thomas Tarcza
Assistant Examiner — Kevin Myhre

(57) **ABSTRACT**

A system according to the principles of the present disclosure includes a starter control module, an engine speed module, and a sensor diagnostic module. The starter control module generates a starter engage signal to engage a starter of an engine. The engine speed module determines a speed of the engine based on input from at least one of a camshaft position sensor and a crankshaft position sensor. The sensor diagnostic module selectively diagnoses a fault in the at least one of the camshaft position sensor and the crankshaft position sensor based on a rate of change in the engine speed before the starter engage signal is generated.

20 Claims, 3 Drawing Sheets



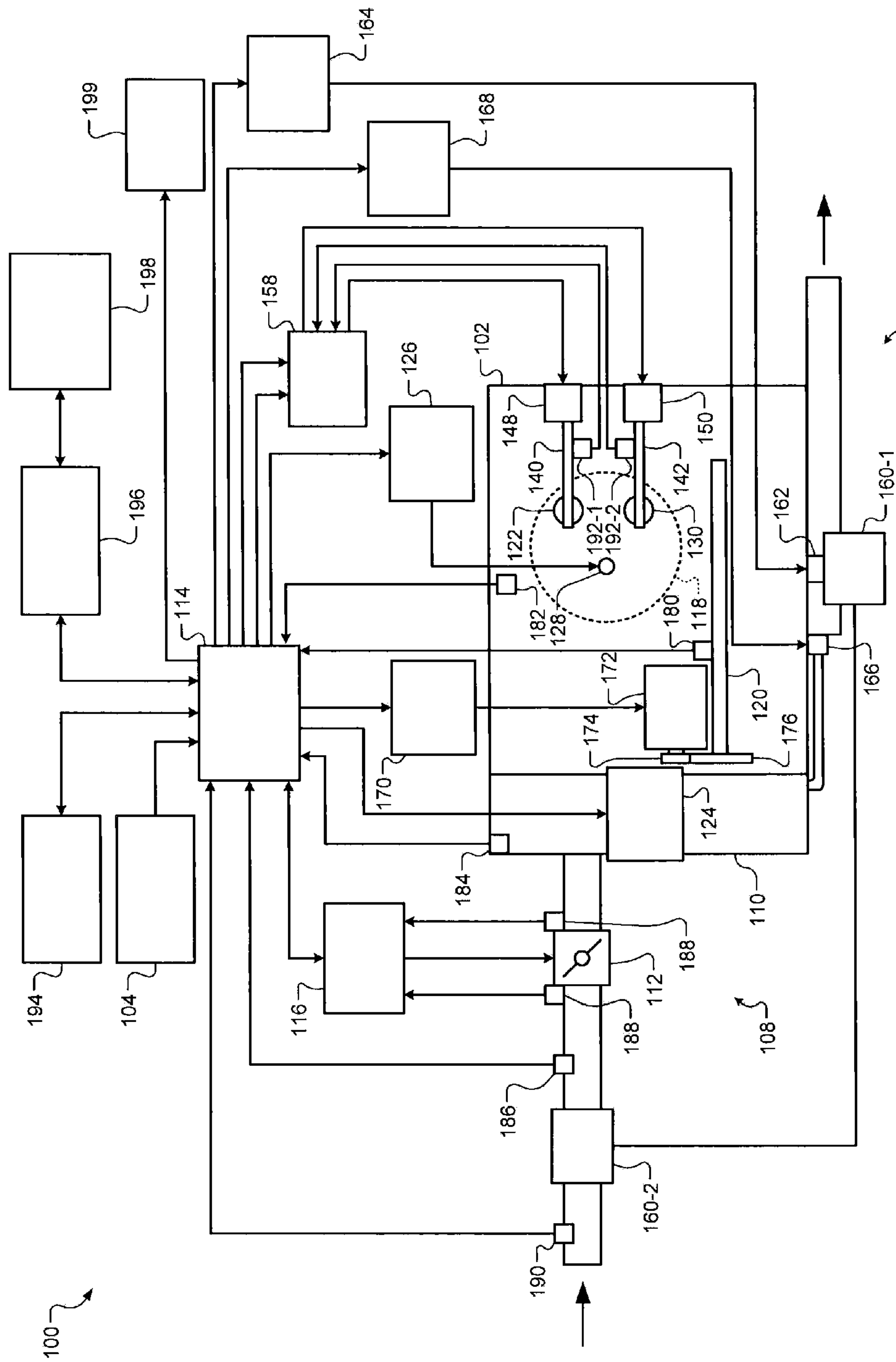

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FIG. 1

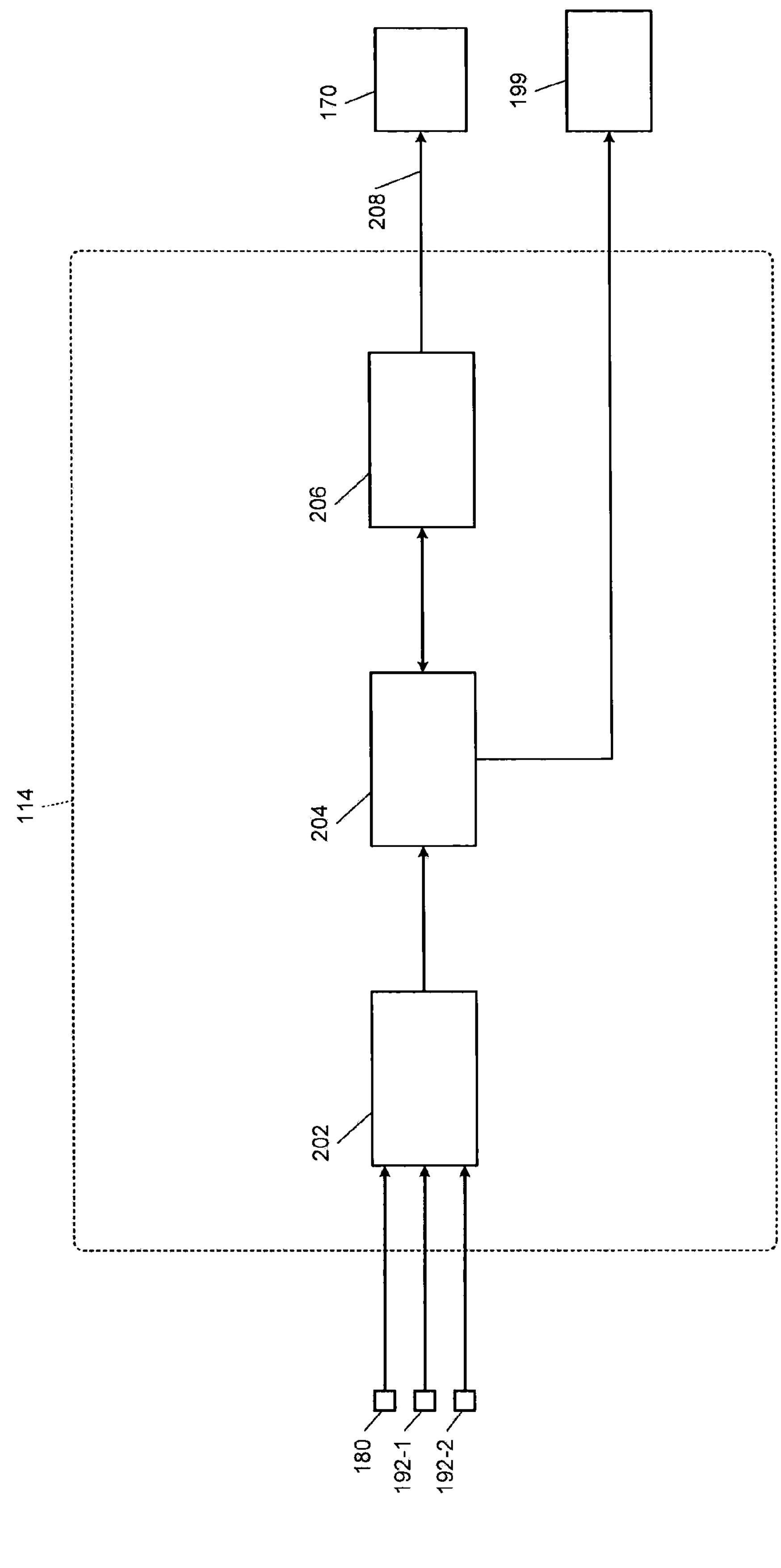

FIG. 2

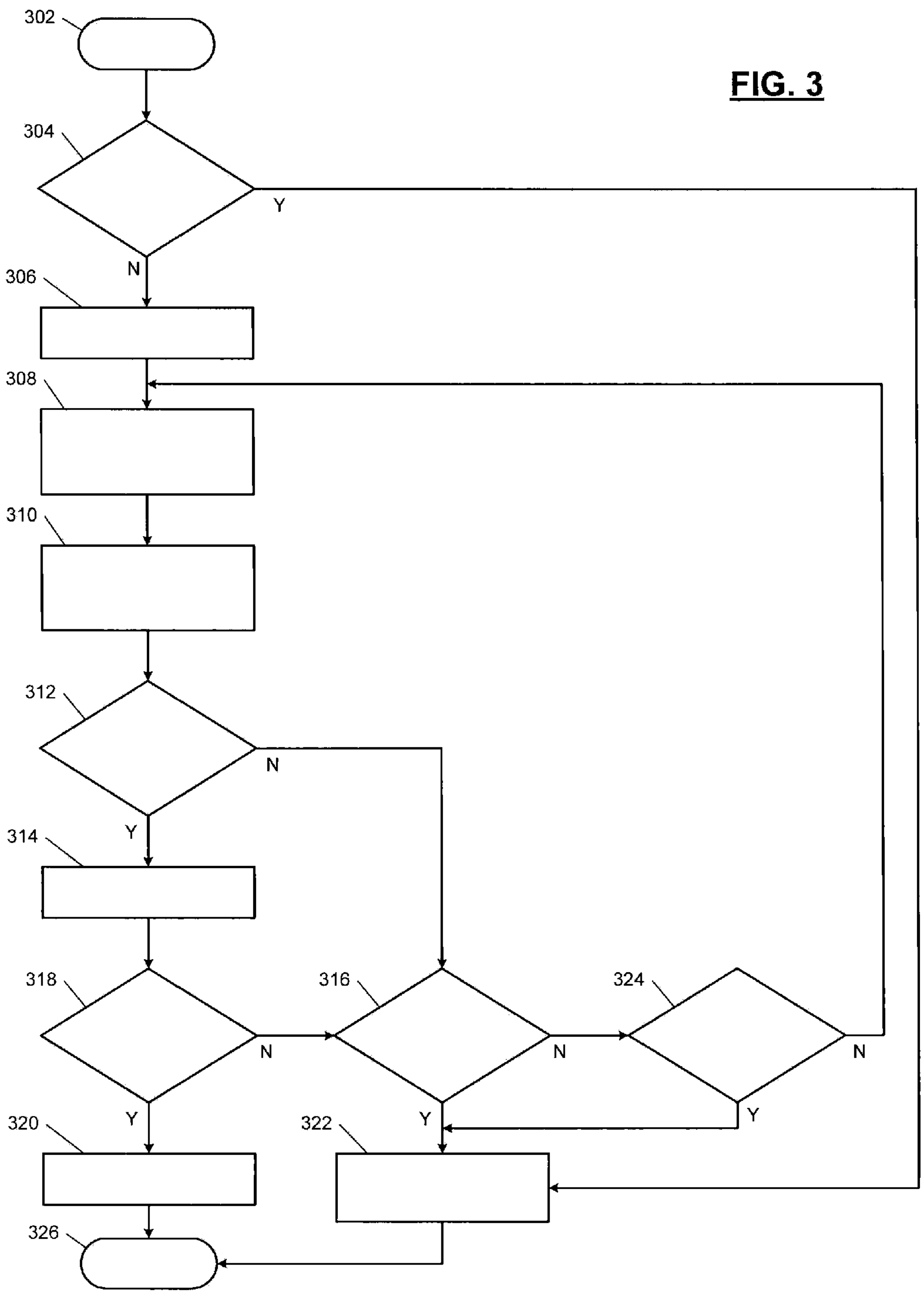

FIG. 3

SYSTEM AND METHOD FOR DIAGNOSING A FAULT IN A CAMSHAFT POSITION SENSOR AND/OR A CRANKSHAFT POSITION SENSOR

FIELD

The present disclosure relates to internal combustion engines, and more specifically, to systems and methods for diagnosing a fault in a camshaft position sensor and/or a crankshaft position sensor.

BACKGROUND

The background description provided here is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly nor impliedly admitted as prior art against the present disclosure.

Internal combustion engines combust an air and fuel mixture within cylinders to drive pistons, which produces drive torque. Air flow into the engine is regulated via a throttle. More specifically, the throttle adjusts throttle area, which increases or decreases air flow into the engine. As the throttle area increases, the air flow into the engine increases. A fuel control system adjusts the rate that fuel is injected to provide a desired air/fuel mixture to the cylinders and/or to achieve a desired torque output. Increasing the amount of air and fuel provided to the cylinders increases the torque output of the engine.

In spark-ignition engines, spark initiates combustion of an air/fuel mixture provided to the cylinders. In compression-ignition engines, compression in the cylinders combusts the air/fuel mixture provided to the cylinders. Spark timing and air flow may be the primary mechanisms for adjusting the torque output of spark-ignition engines, while fuel flow may be the primary mechanism for adjusting the torque output of compression-ignition engines.

SUMMARY

A system according to the principles of the present disclosure includes a starter control module, an engine speed module, and a sensor diagnostic module. The starter control module generates a starter engage signal to engage a starter of an engine. The engine speed module determines a speed of the engine based on input from at least one of a camshaft position sensor and a crankshaft position sensor. The sensor diagnostic module selectively diagnoses a fault in the at least one of the camshaft position sensor and the crankshaft position sensor based on a rate of change in the engine speed before the starter engage signal is generated.

Further areas of applicability of the present disclosure will become apparent from the detailed description, the claims and the drawings. The detailed description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The present disclosure will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. **1** is a functional block diagram of an example engine system according to the principles of the present disclosure;

FIG. **2** is a functional block diagram of an example control system according to the principles of the present disclosure; and

FIG. **3** is a flowchart illustrating an example control method according to the principles of the present disclosure.

In the drawings, reference numbers may be reused to identify similar and/or identical elements.

DETAILED DESCRIPTION

An engine control system typically ensures that the engine is moving before delivering fuel to cylinders of the engine. The system determines whether the engine is moving based on a signal from a position sensor such as a camshaft position sensor or a crankshaft position sensor. In some cases, due to noise in the signal from the position sensor, the system may determine that the engine is moving when the engine is actually not moving. In these cases, the system may deliver fuel to cylinders of the engine when the engine is not running. In turn, the engine may be damaged due to hydrolock, a condition in which the amount of fluid accumulated in a cylinder is greater than the smallest volume of a combustion chamber corresponding to the cylinder.

In addition, an engine control system typically does not engage a starter when an engine is moving to avoid damaging the starter. Thus, if noise in the signal from the position sensor causes the system to determine that the engine is moving when the engine is actually not moving, the system may inhibit starter engagement without setting a diagnostic trouble code. In turn, a driver may be unable to start the engine, and a service technician may be unable to identify the cause of the issue.

A system and method according to the present disclosure prevents these scenarios by diagnosing a fault in the position sensor when the signal from the position sensor exhibits irrational behavior. In one example, the system and method determines an engine speed based on the signal from the position sensor and determines that the signal exhibits irrational behavior when a rate of change in the engine speed is greater than a predetermined rate. In this manner, the system and method distinguishes irrational behavior due to signal noise from unexpected but acceptable engine behavior, such as engine behavior that may occur as a result of a push start.

Referring now to FIG. **1**, an engine system **100** includes an engine **102** that combusts an air/fuel mixture to produce drive torque for a vehicle. The amount of drive torque produced by the engine **102** is based on a driver input from a driver input module **104**. The driver input may be based on a position of an accelerator pedal, a position of a brake pedal, and/or a position of an ignition switch. The driver input may also be based on a cruise control system, which may be an adaptive cruise control system that varies vehicle speed to maintain a predetermined following distance.

Air is drawn into the engine **102** through an intake system **108**. The intake system **108** includes an intake manifold **110** and a throttle valve **112**. The throttle valve **112** may include a butterfly valve having a rotatable blade. An engine control module (ECM) **114** controls a throttle actuator module **116**, which regulates opening of the throttle valve **112** to control the amount of air drawn into the intake manifold **110**.

Air from the intake manifold **110** is drawn into cylinders of the engine **102**. While the engine **102** may include multiple cylinders, for illustration purposes a single representative cylinder **118** is shown. For example only, the engine **102** may include 2, 3, 4, 5, 6, 8, 10, and/or 12 cylinders. The ECM **114** may deactivate some of the cylinders, which may improve fuel economy under certain engine operating conditions.

The engine **102** may operate using a four-stroke cycle. The four strokes, described below, are named the intake stroke, the compression stroke, the combustion stroke, and the exhaust stroke. During each revolution of a crankshaft **120**, two of the four strokes occur within the cylinder **118**. Therefore, two crankshaft revolutions are necessary for the cylinder **118** to experience all four of the strokes.

During the intake stroke, air from the intake manifold **110** is drawn into the cylinder **118** through an intake valve **122**. The ECM **114** controls a fuel actuator module **124**, which regulates fuel injection to achieve a desired air/fuel ratio. Fuel may be injected into the intake manifold **110** at a central location or at multiple locations, such as near the intake valve **122** of each of the cylinders. In various implementations, fuel may be injected directly into the cylinders or into mixing chambers associated with the cylinders. The fuel actuator module **124** may halt injection of fuel to cylinders that are deactivated.

The injected fuel mixes with air and creates an air/fuel mixture in the cylinder **118**. During the compression stroke, a piston (not shown) within the cylinder **118** compresses the air/fuel mixture. The engine **102** may be a compression-ignition engine, in which case compression in the cylinder **118** ignites the air/fuel mixture. Alternatively, the engine **102** may be a spark-ignition engine, in which case a spark actuator module **126** energizes a spark plug **128** to generate a spark in the cylinder **118** based on a signal from the ECM **114**, which ignites the air/fuel mixture. The timing of the spark may be specified relative to the time when the piston is at its topmost position, referred to as top dead center (TDC).

The spark actuator module **126** may be controlled by a spark timing signal specifying how far before or after TDC to generate the spark. Because piston position is directly related to crankshaft rotation, operation of the spark actuator module **126** may be synchronized with crankshaft angle. In various implementations, the spark actuator module **126** may halt provision of spark to deactivated cylinders.

Generating the spark may be referred to as a firing event. The spark actuator module **126** may have the ability to vary the timing of the spark for each firing event. The spark actuator module **126** may even be capable of varying the spark timing for a next firing event when the spark timing signal is changed between a last firing event and the next firing event. In various implementations, the engine **102** may include multiple cylinders and the spark actuator module **126** may vary the spark timing relative to TDC by the same amount for all cylinders in the engine **102**.

During the combustion stroke, combustion of the air/fuel mixture drives the piston down, thereby driving the crankshaft **120**. The combustion stroke may be defined as the time between the piston reaching TDC and the time at which the piston returns to bottom dead center (BDC). During the exhaust stroke, the piston begins moving up from BDC and expels the byproducts of combustion through an exhaust valve **130**. The byproducts of combustion are exhausted from the vehicle via an exhaust system **134**.

The intake valve **122** may be controlled by an intake camshaft **140**, while the exhaust valve **130** may be controlled by an exhaust camshaft **142**. In various implementations, multiple intake camshafts (including the intake camshaft **140**) may control multiple intake valves (including the intake valve **122**) for the cylinder **118** and/or may control the intake valves (including the intake valve **122**) of multiple banks of cylinders (including the cylinder **118**). Similarly, multiple exhaust camshafts (including the exhaust camshaft **142**) may control multiple exhaust valves for the cylinder **118** and/or may control exhaust valves (including the exhaust valve **130**) for multiple banks of cylinders (including the cylinder **118**).

The time at which the intake valve **122** is opened may be varied with respect to piston TDC by an intake cam phaser **148**. The time at which the exhaust valve **130** is opened may be varied with respect to piston TDC by an exhaust cam phaser **150**. A valve actuator module **158** may control the intake and exhaust cam phasers **148** and **150** based on signals from the ECM **114**. When implemented, variable valve lift may also be controlled by the valve actuator module **158**.

The ECM **114** may deactivate the cylinder **118** by instructing the valve actuator module **158** to disable opening of the intake valve **122** and/or the exhaust valve **130**. The valve actuator module **158** may disable opening of the intake valve **122** by decoupling the intake valve **122** from the intake camshaft **140**. Similarly, the valve actuator module **158** may disable opening of the exhaust valve **130** by decoupling the exhaust valve **130** from the exhaust camshaft **142**. In various implementations, the valve actuator module **158** may control the intake valve **122** and/or the exhaust valve **130** using devices other than camshafts, such as electromagnetic or electrohydraulic actuators.

The engine system **100** may include a boost device that provides pressurized air to the intake manifold **110**. For example, FIG. **1** shows a turbocharger including a hot turbine **160-1** that is powered by hot exhaust gases flowing through the exhaust system **134**. The turbocharger also includes a cold air compressor **160-2**, driven by the turbine **160-1**, which compresses air leading into the throttle valve **112**. In various implementations, a supercharger (not shown), driven by the crankshaft **120**, may compress air from the throttle valve **112** and deliver the compressed air to the intake manifold **110**.

A wastegate **162** may allow exhaust to bypass the turbine **160-1**, thereby reducing the boost (the amount of intake air compression) of the turbocharger. The ECM **114** may control the turbocharger via a boost actuator module **164**. The boost actuator module **164** may modulate the boost of the turbocharger by controlling the position of the wastegate **162**. In various implementations, multiple turbochargers may be controlled by the boost actuator module **164**. The turbocharger may have variable geometry, which may be controlled by the boost actuator module **164**.

An intercooler (not shown) may dissipate some of the heat contained in the compressed air charge, which is generated as the air is compressed. The compressed air charge may also have absorbed heat from components of the exhaust system **134**. Although shown separated for purposes of illustration, the turbine **160-1** and the compressor **160-2** may be attached to each other, placing intake air in close proximity to hot exhaust.

The engine system **100** may include an exhaust gas recirculation (EGR) valve **166**, which selectively redirects exhaust gas back to the intake manifold **110**. The EGR valve **166** may be located upstream of the turbocharger's turbine **160-1**. The EGR valve **166** may be controlled by an EGR actuator module **168**.

The ECM **114** controls a starter actuator module **170**, which selectively engages a starter **172** to rotate the crankshaft **120** and thereby start the engine **102**. The starter actuator module **170** may engage the starter **172** by engaging a drive pinion **174** of the starter **172** with a flywheel **176** coupled to the crankshaft **120**. The starter actuator module **170** may also supply power to a motor in the starter **172** that is coupled to the drive pinion **174** to rotate the motor and thereby rotate the crankshaft **120**.

The engine system **100** may measure the position of the crankshaft **120** using a crankshaft position (CKP) sensor **180**.

The temperature of the engine coolant may be measured using an engine coolant temperature (ECT) sensor **182**. The ECT sensor **182** may be located within the engine **102** or at other locations where the coolant is circulated, such as a radiator (not shown).

The pressure within the intake manifold **110** may be measured using a manifold absolute pressure (MAP) sensor **184**. In various implementations, engine vacuum, which is the difference between ambient air pressure and the pressure within the intake manifold **110**, may be measured. The mass flow rate of air flowing into the intake manifold **110** may be measured using a mass air flow (MAF) sensor **186**. In various implementations, the MAF sensor **186** may be located in a housing that also includes the throttle valve **112**.

The throttle actuator module **116** may monitor the position of the throttle valve **112** using one or more throttle position sensors (TPS) **188**. The ambient temperature of air being drawn into the engine **102** may be measured using an intake air temperature (IAT) sensor **190**. The positions of the intake and exhaust camshafts **140** and **142** may be measured using intake and exhaust camshaft position (CMP) sensors **192-1** and **192-2**. The CMP sensors **192-1** and **192-2** may output the camshaft positions to the valve actuator module **158** and the valve actuator module **158** may output the camshaft positions to the ECM **114**, as shown in FIG. **1**. Alternatively, the CMP sensors **192-1** and **192-2** may output the camshaft positions directly to the ECM **114**. The ECM **114** uses signals from the sensors to make control decisions for the engine system **100**.

The ECM **114** may communicate with a transmission control module (TCM) **194** to coordinate shifting gears in a transmission (not shown). For example, the ECM **114** may reduce engine torque during a gear shift. The ECM **114** may communicate with a hybrid control module (HCM) **196** to coordinate operation of the engine **102** and an electric motor **198**. The electric motor **198** may also function as a generator, and may be used to produce electrical energy for use by the vehicle's electrical systems and/or for storage in a battery. In various implementations, various functions of the ECM **114**, the TCM **194**, and the HCM **196** may be integrated into one or more modules.

Before the ECM **114** engages the starter **172** to start the engine **102**, the ECM **114** determines a speed of the engine **102** based on an input from the CKP sensor **180**, the CMP sensor **192-1**, and/or the CMP sensor **192-2**. The ECM **114** diagnoses a fault in the sensor(s) whose input is used to determine the engine speed based on a rate of change in the engine speed before the starter **172** engages. The ECM **114** may set a diagnostic trouble code (DTC) and/or activate a service indicator **199** when a fault in the CKP sensor **180**, the CMP sensor **192-1**, and/or the CMP sensor **192-2** is diagnosed. When activated, the service indicator **199** indicates that service is required using a visual message (e.g., text, a light, and/or a symbol), an audible message (e.g., a chime), and/or a tactile message (e.g., vibration).

Referring now to FIG. **2**, an example implementation of the ECM **114** includes an engine speed module **202**, a sensor diagnostic module **204**, and a starter control module **206**. The engine speed module **202** determines the speed of the engine **102**. The engine speed module **202** may determine the engine speed based on the crankshaft position from the CKP sensor **180**. For example, the engine speed module **202** may calculate the engine speed based on a period that elapses as the crankshaft **120** completes one or more revolutions.

Additionally or alternatively, the engine speed module **202** may determine the engine speed based on the intake camshaft position from the intake CMP sensor **192-1**. For example, the engine speed module **202** may calculate the engine speed based on a period that elapses as the intake camshaft **140** completes one or more revolutions. Additionally or alternatively, the engine speed module **202** may determine the engine speed based on the exhaust camshaft position from the exhaust CMP sensor **192-2**. For example, the engine speed module **202** may calculate the engine speed based on a period that elapses as the exhaust camshaft **142** completes one or more revolutions. The engine speed module **202** outputs the engine speed.

The starter control module **206** generates a starter engage signal **208** to engage the starter **172** based on the driver input and/or engine operating conditions. The starter control module **206** may generate the starter engage signal **208** when a driver adjusts an ignition switch to a crank position. The starter control module **206** may also generate the starter engage signal **208** when the driver releases the brake pedal or depresses the accelerator pedal to automatically restart the engine **102** after the engine **102** is automatically stopped. In addition, after an automatic stop, the starter control module **206** may generate the starter engage signal **208** when the driver takes certain actions or when certain engine operating conditions do not meet predetermined criteria for the automatic stop. For example, the starter control module **206** may generate the starter engage signal **208** when the driver opens a hood of the vehicle. In another example, the starter control module **206** may generate the starter engage signal **208** when a battery state of charge is less than a predetermined value or when the engine coolant temperature is greater than a predetermined temperature. The starter control module **206** outputs the starter engage signal **208** to the starter actuator module **170**. In response, the starter actuator module **170** engages the starter **172**.

The sensor diagnostic module **204** selectively diagnoses a fault in the CKP sensor **180**, the intake CMP sensor **192-1**, and/or the exhaust CMP sensor **192-2** based on a rate of change in the engine speed before the starter engage signal **208** is generated. The sensor diagnostic module **204** may diagnose a fault in the one(s) of the sensors **180**, **192-1**, and **192-2** whose input(s) is used to determine the engine speed (i.e., the one(s) of the sensors **180**, **192-1**, and **192-2** that is being evaluated). The sensor diagnostic module **204** may determine the rate of change in the engine speed. Alternatively, the engine speed module **202** may determine the rate of change in the engine speed and output the rate of change in the engine speed to the sensor diagnostic module **204**.

Referring now to FIG. **3**, a method of diagnosing a fault in a camshaft position sensor and/or a crankshaft position sensor begins at **302**. The method is described in the context of the modules included in the example implementation of the ECM **114** shown in FIG. **2** in order to further describe the functions performed by those modules. However, the particular modules that perform the steps of the method may be different than the description below and/or the method may be implemented apart from the modules of FIG. **2**. For example, the method may be implemented by a single module.

The ECM **114** may begin executing the method at **302** when the engine **102** is not running and before the starter engage signal **308** is generated. When the engine **102** is not running because the driver switched the ignition switch to an off position, the ECM **114** may begin executing the method at **302** when the ECM **114** is initialized, which may occur when power is initially supplied to the ECM **114**. Power may be initially supplied to the ECM **114** when the driver switches the ignition switch to an on position or the crank position, or when a door of the vehicle is unlocked or opened. When the engine **102** is not running due to an automatic stop, the ECM **114** may begin executing the method at **302** as soon as the engine **102** is stopped.

At **304**, the sensor diagnostic module **204** determines whether the starter engage signal **208** is generated. The sensor diagnostic module **204** may determine whether the starter engage signal **208** is generated based on an input received from the starter control module **206**. If the starter engage signal **208** is generated, the sensor diagnostic module **204** continues at **322**. Otherwise, the sensor diagnostic module **204** continues at **306**.

At **306**, the sensor diagnostic module **204** starts a timer. At **308**, the engine speed module **202** determines the engine speed. The engine speed module **202** may determine the engine speed based on an input from the CKP sensor **180**, the intake CMP sensor **192-1**, and/or the exhaust CMP sensor **192-2** as described above with reference to FIG. **2**. The engine speed module **202** may determine the engine speed based on an input from the one(s) of the CKP sensor **180**, the intake CMP sensor **192-1**, and the exhaust CMP sensor **192-2** that is being evaluated.

At **310**, the sensor diagnostic module **204** determines a change in the engine speed during a first period. The first period may have a first predetermined duration (e.g., 12.5 milliseconds). For example, the engine speed module **202** may determine the engine speed at predetermined times, and the first period may be equal to the amount of time between the predetermined times. The change in the engine speed may be a total amount of change in the engine speed over the first period, in which case the period of the change in the engine speed may be equal to the first period. Alternatively, the change in the engine speed may be a maximum absolute change in the engine speed during the first period, in which case the period of the change in the engine speed may be less than or equal to the first period.

At **312**, the sensor diagnostic module **204** determines whether the change in the engine speed is greater than a predetermined amount (e.g., 1000 revolutions per minute). When the change in the engine speed is greater than the predetermined amount, the sensor diagnostic module **204** continues at **314** and increments a counter (e.g., increases the counter by one) corresponding to the one(s) of the CKP sensor **180**, the intake CMP sensor **192-1**, and the exhaust CMP sensor **192-2** that is being evaluated. Otherwise, the sensor diagnostic module **204** continues at **316**.

At **318**, the sensor diagnostic module **204** determines whether the counter is greater than or equal to a predetermined count (e.g., **4**). If the counter is greater than or equal to the predetermined count, the sensor diagnostic module **204** continues at **320**. Otherwise, the sensor diagnostic module **204** continues at **316**. At **320**, the sensor diagnostic module **204** diagnoses a fault in the one(s) of the sensors **180**, **192-1**, and **192-2** that is being evaluated.

At **316**, the sensor diagnostic module **204** determines whether the starter engage signal **308** is generated. The sensor diagnostic module **204** may determine whether the starter engage signal **308** is generated based on an input from the starter control module **206**. If the starter engage signal **308** is generated, the method continues at **322**. Otherwise, the sensor diagnostic module **204** continues at **324**. At **322**, the sensor diagnostic module **204** does not diagnose a fault in the one(s) of the sensors **180**, **192-1**, and **192-2** that is being evaluated. In addition, the sensor diagnostic module **204** may reset the counter and/or the timer to zero.

At **324**, the sensor diagnostic module **204** determines whether the timer is greater than or equal to a second period. The second period may begin when the timer is started at **306** and may have a second predetermined duration (e.g., 4 seconds). If the timer is greater than or equal to the second period, the sensor diagnostic module **204** continues at **322**. Otherwise, the method continues at **308**. The method ends at **326**.

In the discussion above, the sensor diagnostic module **204** determines a change in the engine speed during the first period and diagnoses a fault in the sensor used to determine the engine speed based on the change in the engine speed. Alternatively, the sensor diagnostic module **204** may determine a rate of change in the engine speed by dividing a change in the engine speed by a corresponding period, and diagnose a fault in the sensor based on the rate of change in the engine speed. For example, the sensor diagnostic module **204** may diagnose a fault in the sensor when the rate of change in the engine speed is greater than a predetermined rate.

The foregoing description is merely illustrative in nature and is in no way intended to limit the disclosure, its application, or uses. The broad teachings of the disclosure can be implemented in a variety of forms. Therefore, while this disclosure includes particular examples, the true scope of the disclosure should not be so limited since other modifications will become apparent upon a study of the drawings, the specification, and the following claims. As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A or B or C), using a non-exclusive logical OR. It should be understood that one or more steps within a method may be executed in different order (or concurrently) without altering the principles of the present disclosure.

In this application, including the definitions below, the term module may be replaced with the term circuit. The term module may refer to, be part of, or include an Application Specific Integrated Circuit (ASIC); a digital, analog, or mixed analog/digital discrete circuit; a digital, analog, or mixed analog/digital integrated circuit; a combinational logic circuit; a field programmable gate array (FPGA); a processor (shared, dedicated, or group) that executes code; memory (shared, dedicated, or group) that stores code executed by a processor; other suitable hardware components that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip.

The term code, as used above, may include software, firmware, and/or microcode, and may refer to programs, routines, functions, classes, and/or objects. The term shared processor encompasses a single processor that executes some or all code from multiple modules. The term group processor encompasses a processor that, in combination with additional processors, executes some or all code from one or more modules. The term shared memory encompasses a single memory that stores some or all code from multiple modules. The term group memory encompasses a memory that, in combination with additional memories, stores some or all code from one or more modules. The term memory may be a subset of the term computer-readable medium. The term computer-readable medium does not encompass transitory electrical and electromagnetic signals propagating through a medium, and may therefore be considered tangible and non-transitory. Non-limiting examples of a non-transitory tangible computer readable medium include nonvolatile memory, volatile memory, magnetic storage, and optical storage.

The apparatuses and methods described in this application may be partially or fully implemented by one or more computer programs executed by one or more processors. The computer programs include processor-executable instructions that are stored on at least one non-transitory tangible computer readable medium. The computer programs may also include and/or rely on stored data.

What is claimed is:

1. A system comprising:

a starter control module that generates a starter engage signal to engage a starter of an engine;

an engine speed module that determines a speed of the engine based on input from at least one of a camshaft position sensor and a crankshaft position sensor; and

a sensor diagnostic module that selectively diagnoses a fault in the at least one of the camshaft position sensor and the crankshaft position sensor based on a rate of change in the engine speed before the starter engage signal is generated.

2. The system of claim 1 wherein the sensor diagnostic module selectively diagnoses a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when a change in the engine speed during a first period is greater than a predetermined amount.

3. The system of claim 2 wherein the sensor diagnostic module:

increments a counter during a second period when the change in the engine speed is greater than the predetermined amount; and

diagnoses a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the corresponding counter is greater than or equal to a predetermined count during the second period.

4. The system of claim 3 wherein the second period begins when the engine is stopped and before the starter engage signal is generated.

5. The system of claim 4 wherein the first period has a first predetermined duration and the second period has a second predetermined duration.

6. The system of claim 5 wherein the sensor diagnostic module resets the counter to zero when the second period ends.

7. The system of claim 5 wherein the sensor diagnostic module does not diagnose a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the starter engages before the second period ends.

8. The system of claim 5 wherein the sensor diagnostic module does not diagnose a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the starter engages before the counter increases to a value that is greater than or equal to the predetermined count during the second period.

9. The system of claim 1 wherein the starter control module generates the starter engage signal to engage the starter when a driver adjusts an ignition switch to a crank position.

10. The system of claim 1 wherein the starter control module generates the starter engage signal to engage the starter based on at least one of (i) a driver input and (ii) an engine operating condition.

11. A method comprising:

generating a starter engage signal to engage a starter of an engine;

determining a speed of the engine based on input from at least one of a camshaft position sensor and a crankshaft position sensor; and

selectively diagnosing a fault in the at least one of the camshaft position sensor and the crankshaft position sensor based on a rate of change in the engine speed before the starter engage signal is generated.

12. The method of claim 11 further comprising selectively diagnosing a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when a change in the engine speed during a first period is greater than a predetermined amount.

13. The method of claim 12 further comprising:

incrementing a counter during a second period when the change in the engine speed is greater than the predetermined amount; and

diagnosing a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the corresponding counter is greater than or equal to a predetermined count during the second period.

14. The method of claim 13 wherein the second period begins when the engine is stopped and before the starter engage signal is generated.

15. The method of claim 14 wherein the first period has a first predetermined duration and the second period has a second predetermined duration.

16. The method of claim 15 further comprising resetting the counter to zero when the second period ends.

17. The method of claim 15 further comprising not diagnosing a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the starter engages before the second period ends.

18. The method of claim 15 further comprising not diagnosing a fault in the at least one of the camshaft position sensor and the crankshaft position sensor when the starter engages before the counter increases to a value that is greater than or equal to the predetermined count during the second period.

19. The method of claim 11 further comprising generating the starter engage signal to engage the starter when a driver adjusts an ignition switch to a crank position.

20. The method of claim 11 further comprising generating the starter engage signal to engage the starter based on at least one of (i) a driver input and (ii) an engine operating condition.

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